SOIL SURVEY OF

Edmunds County, South Dakota

United States Department of Agriculture
Soil Conservation Service
in cooperation with
South Dakota Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1964–72. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Edmunds County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Edmunds County are shown on the detailed map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to

Sheets.

On each sheet of the detailed map soil areas

over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the pasture and windbreak groups.

Ranchers and others can find, under "Range,"

ability for range, and also the names of many of the plants that grow on each range site.

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SOIL SURVEY OF EDMUNDS COUNTY, SOUTH DAKOTA

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SOILS SURVEYED BY EDGAR H. ENSZ, MERLE M. KOST, ADRIAN A. PARMETER, THOMAS M. SCHUMACHER, AND LOREN D. SCHULTZ, SOIL CONSERVATION SERVICE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

EDMUNDS COUNTY, in the north-central part of South Dakota (fig. 1), is 48 miles from east to west and 24 miles from north to south. The total area is 739,200 acres. The population in 1970 was 5,548. Ipswich, the county seat, is the largest town. Smaller towns and villages are Bowdle, Craven, Hosmer, Loyalton, Mina, and Roscoe.

Edmunds County is in two physiographic areas. The central and western parts are on the Missouri Coteau (*3*) [2] where relief is mostly undulating to hilly, and elevation differences range to as much as 100 feet. Many potholes or closed depressions are in this part of the county, and the drainage pattern is poorly defined. The

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Edmunds County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and nature of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show

General Soil Map

The General Soil Map at the back of this survey shows, in color, the soil associations in Edmunds County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people

3. *Williams-Bowbells association*

Deep, well drained and moderately well drained, nearly level to undulating loamy soils formed in glacial till

This association is a glacial till plain, mainly of rises interrupted by narrow swales and sags and many closed depressions or potholes (fig. 3). Slopes generally are short and the soils are mostly gently undulating, but some areas are nearly level and some are undulating or steeper around the potholes. Differences in elevation range from 10 to 30 feet. The drainage pattern is poorly defined in much of the association.

This association makes up about 51 percent of the county. It is about 40 percent Williams soils, 20 percent Bowbells soils, and 40 percent soils of minor extent.

Williams soils are on the rises and are well drained. The surface layer is dark grayish-brown loam and the subsoil is grayish-brown and light brownish-gray clay loam. The underlying material is calcareous, light-gray and light yellowish-brown clay loam.

Bowbells soils are in swales and are moderately well drained. They have a surface layer of dark grayish-brown loam and a thick subsoil of dark grayish-brown brown, and grayish-brown clay loam. The underlying material is calcareous, light brownish-gray clay loam.

The minor soils in this association are Bryant, Mondamin, Temvik, and Vida soils on the higher parts of

and Niobell and Noonan soils on flats and some slight rises.

The major soils have medium or high fertility and high available water capacity. Runoff is mostly medium and ponds in the closed depressions. Permeability is moderate in the subsoil, but is moderately slow in the underlying glacial till. Conserving moisture, controlling erosion and soil blowing, and maintaining fertility are the main concerns of management.

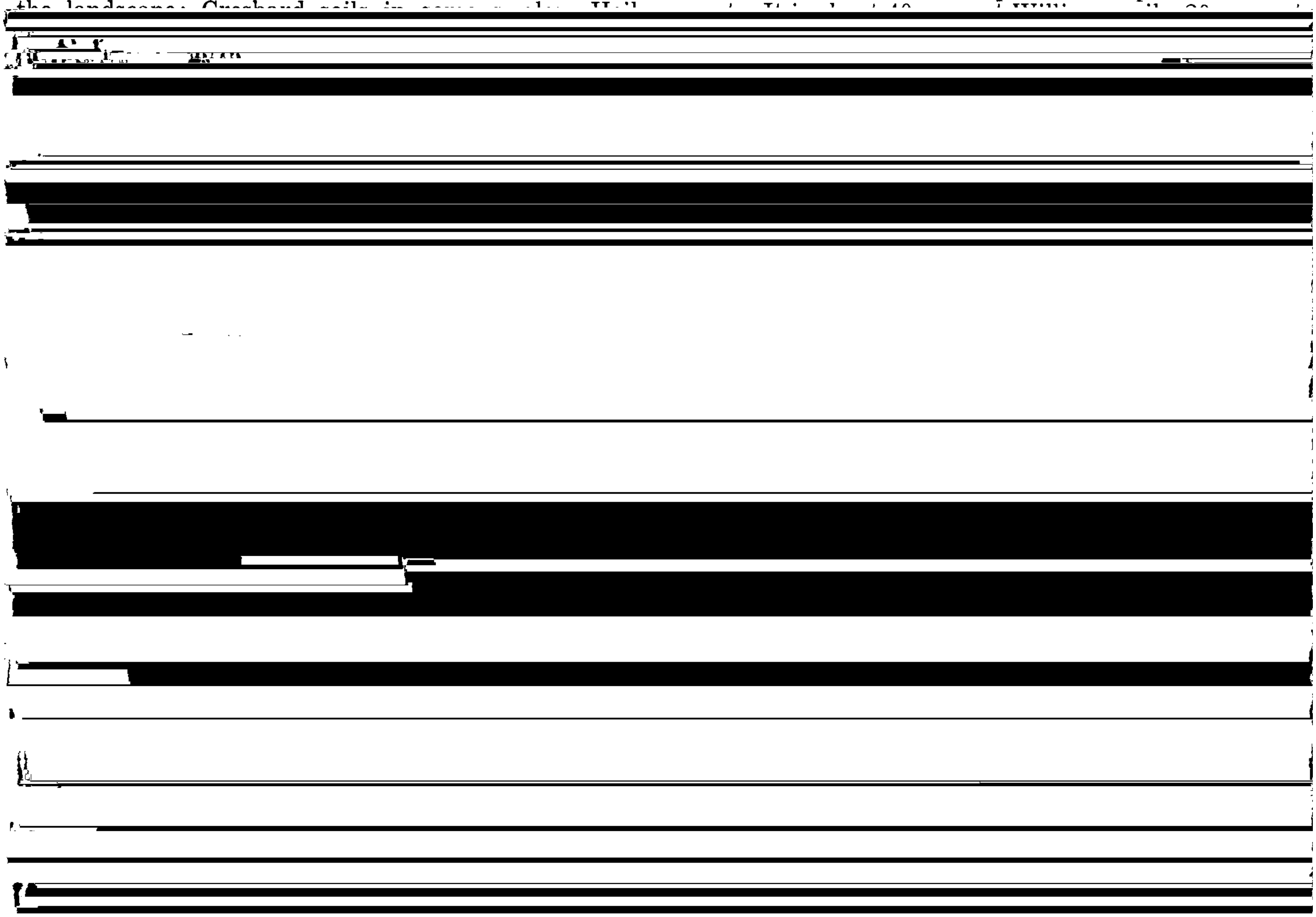
Much of this association is cultivated. Corn, wheat, oats, rye, and alfalfa are the main crops. Some areas are still in native grass and are used for grazing and hay. Growing cash crops and feeding beef cattle are the main farm enterprises.

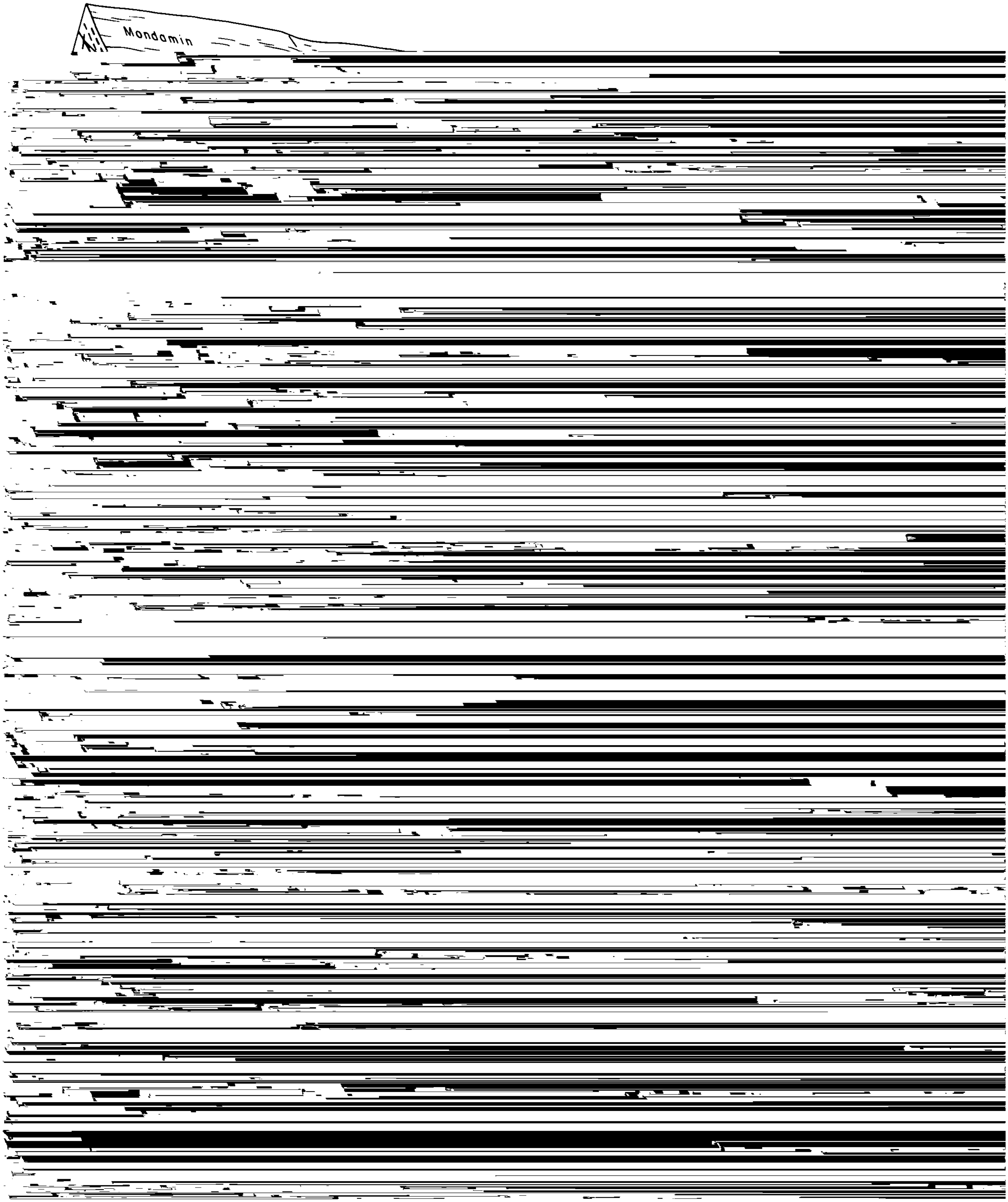
4. *Williams-Vida association*

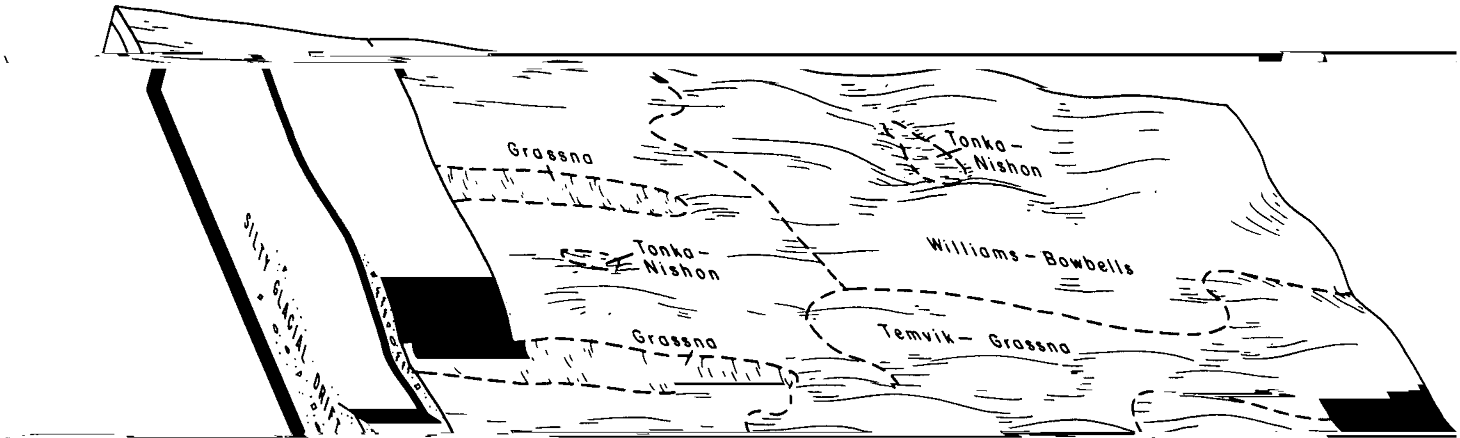
Deep, well-drained, gently undulating to hilly loamy soils formed in glacial till

This association is a glacial till plain, mainly of ridges and knolls interrupted by narrow swales that terminate in closed depressions. Slopes generally are short and the soils are mostly undulating to hilly. Differences in elevation range from 30 to 100 feet. Many of the depressions are deeply entrenched and the drainage pattern is poorly defined. Stones and boulders are on some of the ridges and knolls.

This association makes up about 15 percent of the




Mondamin


Grassna
Tonko-Nishon
Tonko-Nishon
Williams-Bowbells
Grassna
Temvik-Grassna
SILTY GLACIAL DRIFT

brownish-gray clay loam. The underlying material is calcareous, light-gray and light yellowish-brown clay [redacted]

Bowbells, Bryant, and Grassna soils are the most extensive of the minor soils. Bowbells and Grassna soils are in swales. Bryant soils are intermingled with Temvik soils. Less extensive are Bowdle and Lehr soils in places underlain by sand and gravel; Nishon, Parnell, [redacted]

This association is a glacial outwash plain that is somewhat lower in elevation than the nearby Temvik- [redacted]

sloping, but steeper areas are on the sides of drainageways. Slopes generally are long and smooth, but some are short and irregular. Very few closed depressions are in the areas, and the drainage pattern is well defined.

[redacted]

sand and gravel is absent. Less extensive are Bearden, Bowbells, Divide, Grassna, and Spottswood soils in swales and along drainageways; Bogan soils on bottom

from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the

Bearden Series

The Bearden series consists of deep, somewhat poorly drained, nearly level, calcareous loamy soils on uplands. These soils formed in silty glacial drift or in lacustrine sediments. The native vegetation was

Included with this soil in mapping are Divide, Grassna, and Spottswood soils. Divide soils are on the margins of some areas. Grassna and Spottswood soils are on very slight rises.

This Bearden soil has a high content of lime. Soil blowing is medium segregations of lime; violent effervescence; moderately alkaline; gradual, smooth boundary.

C2—32 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common, fine and medium, distinct mottles of strong brown (7.5YR 5/8) and light gray (10YR 7/1); massive; hard, friable, slightly sticky and slightly plastic; common fine segregations of lime; strong effervescence; moderately alkaline.

Depth to carbonates ranges from 22 to 40 inches. Reaction ranges from medium acid to neutral in the A horizon and from slightly acid to mildly alkaline in the B2t horizon. In places the A horizon is dark gray. It is loam or silt loam and ranges from 5 to 15 inches in thickness. The B2t horizon ranges from dark grayish brown to pale brown in hue of 10YR or 2.5Y. Some pedons have a B3 horizon. The C horizon ranges from grayish brown to light yellowish brown in hue of 10YR or 2.5Y. Mottles are faint or distinct in the lower part of the B horizon or in the C horizon, but some pedons lack mottles. The C horizon commonly is clay loam, but ranges from loam to silty clay loam. Some pedons have few or common segregations of gypsum in the lower part of the C horizon.

Bowbells soils are in swales like Grassna soils and are near Williams soils. They contain less silt and very fine sand in the B horizon than Grassna soils. They have moist colors of very dark grayish brown or darker that extend to greater depths than in Williams soils.

Bc—Bowbells-Cresbard loams. This mapping unit is about 50 percent Bowbells soils, 30 percent Cresbard soils, and 20 percent other soils. Areas are long and narrow and range from 20 to 80 acres in size. Slopes are 0 to 2 percent. The soils are in swales and along drainageways on uplands. The Cresbard soil has the profile described as representative of the series, but in T. 122 N., R. 67 W. the surface layer is sandy loam in places.

Included with these soils in mapping are small areas of Nishon, Parnell, Ranslo, and Tonka soils. Nishon, Parnell, and Tonka soils are in small potholes, most of which are identified on the soil map by a wet spot symbol. Ranslo soils are in low areas where the swales merge into bottom land along drainageways.

Runoff is slow. In some years, fieldwork is delayed by wetness caused by runoff from adjacent soils, but in most years the additional moisture is beneficial. Soil blowing is a slight hazard on these soils. Conserving moisture is the chief management need.

These soils are well suited to all crops commonly grown in the county. Much of the acreage is cultivated. A few areas are in native grass and are used for grazing and hay. Capability unit IIc-3; Bowbells soil in Overflow range site, windbreak group 1; Cresbard soil in Clayey range site, windbreak group 4.

Bowdle Series

The Bowdle series consists of well-drained, nearly level to undulating loamy soils on uplands. These soils are moderately deep over sand and gravel. They formed in loamy alluvium. The native vegetation was a mixture of tall, mid, and short grasses.

In a representative profile the surface layer is dark

fragments; strong effervescence (14 percent lime); moderately alkaline.

Depth to free carbonates ranges from 12 to 27 inches. The A horizon is dark grayish brown or grayish brown. It commonly is loam or silt loam, but in places is light clay loam or light silty clay loam. It ranges from 5 to 8 inches in thickness. The B2 horizon ranges from dark grayish brown to brown. It commonly is clay loam, but in places is loam, silt loam, or silty clay loam. The B2 horizon has prismatic structure that is weak or moderate. It is 6 to 19

Included with this soil in mapping are small areas of Tally, Williams, and Zahill soils. Tally and Williams soils are intermingled with Bryant soils. Zahill soils are on the tops of some of the ridges and knolls.

Runoff is medium, and the hazard of erosion is severe. Controlling erosion is the chief management need.

This soil is well suited to all crops commonly grown in the county, but the hazard of erosion limits row crops. Most of the acreage is cultivated. Capability unit

6 inches thick. The subsoil, about 16 inches thick, is grayish-brown heavy clay loam. It is very hard when

horizon than both of those soils. They also contain more sodium in the B or C horizon than Bowbells soils.

Cresbard soils have moderate or high content of organic matter and medium fertility. Available water

The Divide series consists of moderately well drained

Included with this soil in mapping are small areas of Bowdle and Spottswood soils on very slight rises.

brown (10YR 5/4) stains, dark yellowish brown (10YR 3/4) moist; about 60 percent fine chips and fragments of soft shale; moderately alkaline;

moderate, medium, subangular blocky; hard, friable; neutral; abrupt, smooth boundary.

B22—21 to 25 inches, light olive-brown (2.5Y 5/4) loam, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; mildly alkaline; abrupt, wavy boundary.

C1ca—25 to 35 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, fine and medium, subangular blocky structure; slightly hard, very friable; few fine segregations of lime; strong effervescence; mildly alkaline; clear, wavy boundary.

C2—35 to 60 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; common, fine and medium, distinct mottles of light gray (10YR 7/1) and yellowish brown (10YR 5/6); massive, slightly hard, very friable; strong effervescence; moderately alkaline.

Depth to free carbonates ranges from 22 to 40 inches. The A horizon commonly is loam but in places is silt loam or light clay loam. It is 10 to 16 inches thick. The B2 horizon is dark grayish-brown to light olive-brown loam or light clay loam that is less than 15 percent fine or coarser sand. It is 12 to 24 inches thick. Some pedons have a B3 horizon. Segregations of lime in the B3ca and Cca horizons are few or common and fine or medium. Some pedons lack mottles in the C horizon.

Grassna soils are similar to Bowbells soils and are near Bryant soils. They contain more silt and very fine sand in the B horizon than Bowbells soils. They have a thicker A horizon than Bryant soils.

Harriet soils have moderate content of organic matter and low or medium fertility. Available water capacity is moderate, and permeability is slow. Most areas are subject to occasional flooding. Depth to a seasonal water table is less than 4 feet in most years.

Most of the acreage is still in native grass and is used for hay and grazing.

In Edmunds County, Harriet soils are mapped only in complex with Ranslo soils.

Representative profile of Harriet silt loam in an area of Ranslo-Harriet silt loams, 1,215 feet west and 126 feet south of the northeast corner of sec. 35, T. 122 N., R. 68 W.

A2—0 to 4 inches, gray (10YR 5/1) silt loam, black (10YR 2/1) moist; moderate, medium, subangular blocky structure parting to moderate, thin and medium platy; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.

B21t—4 to 8 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong, very coarse columnar structure; very hard, very firm, sticky, plastic; coatings of gray (10YR 5/1) on column tops; mildly alkaline; clear, smooth boundary.

B22t—8 to 12 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate, medium, prismatic structure parting to moderate, medium blocky; very hard, very firm, sticky and plastic; few fine segregations of salts; moderately alkaline; abrupt, smooth boundary.

B23t—12 to 20 inches, gray (10YR 5/1) silty clay, very loam. It is 1 to 4 inches thick. The B21t horizon ranges loam, dark grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium and fine, subangular blocky structure; slightly hard, very friable; 10 percent fine gravel; slight effervescence; mildly alkaline; clear, wavy boundary.

IIC1—16 to 42 inches, light-gray (2.5Y 7/2) and light brownish-gray (2.5Y 6/2) sand and gravel, dark grayish brown (2.5Y 4/2) moist; single grained; loose; strong effervescence; mildly alkaline; abrupt, smooth boundary.

IIC2—42 to 60 inches, light brownish-gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose; strong effervescence; mildly alkaline.

Depth to sand and gravel ranges from 10 to 20 inches. The A horizon commonly is loam, but in places it is fine sandy loam. It is 5 to 8 inches thick. The B2 horizon is dark grayish-brown to light brownish-gray loam or light

tered on the surface on the higher parts of the landscape. The Lehr soil is in the higher part. The Bowdle soil has a thinner surface layer than that in the profile described as representative of the series. It is in the lower part of the landscape and in swales.

Included with these soils in mapping are small areas of Bryant and Wabek soils. Bryant soils are in the low areas. Wabek soils are on the tops of the low ridges and knolls.

Runoff is slow to medium. These soils are moderately susceptible to erosion and soil blowing. They also are droughty because of the underlying sand and gravel. Controlling erosion and soil blowing and conserving moisture are the chief management needs.

These soils are best suited to early maturing small grain. Most of the acreage is cultivated. A few areas moist; strong, very coarse, columnar structure; extremely hard, firm; light brownish-gray (10YR 6/2) coatings on tops of columns; neutral; clear, smooth boundary.

B3ca—19 to 25 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very coarse, prismatic structure; hard very friable; few fine segregations of salt and lime; slight effervescence; strongly alkaline; clear, smooth boundary.

C1—25 to 32 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, very friable; few fine masses and

to clay loam. In places these soils are underlain by sand and gravel. Some of the soils are calcareous at or near the surface, but some are noncalcareous.

Loamy Fluvaquents have medium to high fertility. Available water capacity is high. Soil areas are subject to flooding, and a seasonal water table occurs in some areas.

Lv—Loamy Fluvaquents. These mixed alluvial soils are on bottom land along small creeks and drainageways. Areas are long and narrow in shape and range

In Edmunds County, Miranda soils are mapped only with Niobell soils.

Representative profile of Miranda loam in an area of Niobell-Miranda loams, 0 to 3 percent slopes, 264 feet south and 90 feet west of the northeast corner of sec. 22, T. 124 N., R. 66 W.

A2—0 to 4 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular structure parting to weak, thin, platy; hard, friable; neutral; abrupt, smooth boundary.

B21t—4 to 7 inches, grayish-brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; strong, fine and medium, columnar structure; extremely hard, very firm, sticky and plastic; light brownish-gray (10YR 6/2) coatings on tops of columns; mildly alkaline; abrupt, smooth boundary.

B22t—7 to 10 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, blocky; very hard, very firm, sticky and plastic; moderately alkaline; clear, wavy boundary.

B3sa—10 to 16 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure; hard, firm, sticky and plastic; common fine segregations of salts; strongly alkaline; abrupt, wavy boundary.

C1casa—16 to 30 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine, distinct mottles of strong brown (7.5YR 5/8) moist; hard, firm, sticky and plastic; common fine segregations of lime and salts; strong effervescence; strongly alkaline, clear, smooth boundary.

C2cs—30 to 38 inches, pale yellow (2.5Y 7/4) clay loam

In a representative profile the surface layer is dark grayish-brown silty clay loam about 6 inches thick. The subsoil is about 15 inches thick. It is dark grayish-brown silty clay in the upper part and calcareous, light brownish-gray and grayish-brown silty clay loam in the lower part. The upper part is very hard when dry and firm when moist. The underlying material is calcareous, light brownish-gray and light-gray silty clay loam.

Mondamin soils have moderate or high content of organic matter and medium fertility. Available water capacity is high, and permeability is moderately slow or slow.

Most of the acreage is cultivated. A few areas are still in native grass and are used for hay or grazing.

Representative profile of Mondamin silty clay loam, 0 to 2 percent slopes, 1,990 feet east and 210 feet north of the southwest corner of sec. 3, T. 122 N., R. 71 W.

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate, fine and medium, granular structure; hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt, smooth boundary.

B2t—6 to 13 inches, dark grayish-brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; weak, medium, prismatic structure parting to moderate, medium and coarse, blocky; very hard, firm, sticky and plastic; neutral; abrupt, wavy boundary.

B31ca—13 to 21 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium and coarse, blocky and subgrayish brown to brown or light olive brown in hue of 10YR or 2.5Y. It is silty clay or heavy silty clay loam and has weak or moderate, medium or coarse, prismatic structure that parts to moderate or strong blocky. In places the C horizon is loam or clay loam glacial till below a depth of 40 inches. Mottles are few to many and faint or distinct. Dark-colored tongues extend into the C horizon in some pedons.

Mondamin soils have a more clayey B horizon than the

Runoff is slow on the Mondamin soil and very slow on the Heil soil. The Mondamin soil loses tilth if cultivated. The clayey subsoil takes in water slowly. The Heil soil has very poor tilth. The dense claypan subsoil takes in water very slowly, and the sodium content affects crop growth. Controlling soil blowing, improving water intake, and maintaining tilth are the

B3ca—26 to 30 inches, light yellowish-brown (2.5Y 6/3) clay loam, dark grayish brown (2.5Y 4/2) moist; few, fine, distinct relict mottles of strong brown (7.5YR 5/8); weak, coarse, prismatic structure; hard, firm, sticky and plastic; few fine segregations of lime; slight effervescence; strongly alkaline; clear, smooth boundary.

C1ca—30 to 40 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few, fine, distinct relict mottles of strong brown (7.5YR 5/8); massive; hard, firm, sticky and plastic; many, medium segregations of lime; strong effervescence; strongly alkaline; gradual, smooth

there are small low spots. Both soils have the profiles described as representative of their series.

Included with these soils in mapping are small areas of Bowbells, Bryant, Grassna, Heil, Miranda, Tally, and Williams soils. Williams soils are the most extensive. They make up as much as 30 percent of some mapped areas. Bowbells and Grassna soils are in swales. Bryant, Tally, and Williams soils are on the higher part of the landscape. Heil soils are in small closed depressions. Miranda soils are on the lower part adjacent to swales tinct mottles of reddish yellow (7.5YR 7/6); moderate, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; shiny surfaces on peds; mildly alkaline; abrupt, wavy boundary.

B3ca—22 to 32 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few, fine, distinct mottles of reddish yellow (7.5YR 7/6); weak, medium, subangular blocky structure; hard, firm, sticky and plastic; common fine segregations of lime; violent effervescence; moderately alkaline; clear, wavy boundary.

Cca—32 to 60 inches, light olive-gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; many, fine, distinct mottles of reddish yellow (7.5YR 6/8); massive; hard, firm, sticky and plastic; many fine and medium segregations of lime; violent effervescence; moderately alkaline.

The solum is 25 to 45 inches thick. Depth to free carbonates ranges from 16 to 35 inches. The A1 horizon is dark gray to grayish brown and commonly is silt loam but is loam or silty clay loam in places. It ranges to as much as 4 inches in thickness, but some pedons lack an A1 horizon. The A2 horizon is silt loam or loam and is 4 to 7 inches thick. The B2t horizon is dark gray to grayish brown. It commonly is clay, but in places it is silty clay or heavy silty clay loam. Some pedons have prismatic instead of columnar structure in the B21t horizon. The C horizon ranges from gray to light olive gray. Mottles in the B and C horizons are faint to prominent.

Nishon soils are in closed depressions like Parnell and Tonka soils. They are not so poorly drained as Parnell soils and, unlike Parnell soils, have a distinct A2 horizon. Nishon soils have a thinner A1 horizon than Tonka soils.

Noonan Series

The Noonan series consists of deep, moderately well

slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt, smooth boundary.

B21t—10 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong, medium, columnar structure parting to strong, fine, blocky; very hard, firm, sticky and plastic; coatings of light brownish-gray loam on column tops, very dark grayish brown (10YR 3/2) moist; shiny coats on faces of peds; mildly alkaline; clear, smooth boundary.

B22t—14 to 18 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, blocky; very hard, firm, sticky and plastic; shiny coats on faces of peds; moderately alkaline; abrupt, wavy boundary.

B3cs—18 to 22 inches, light olive-brown (2.5Y 5/3) clay loam, very dark grayish brown (2.5Y 3/2) crushing to dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; hard, firm, sticky and plastic; common fine nests of gypsum; strongly alkaline; abrupt, smooth boundary.

C1ca—22 to 32 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few, fine, distinct relict mottles of reddish yellow (7.5YR 6/8) and gray (5Y 6/1); massive; hard, firm, sticky and plastic; few fine nests of gypsum; common, medium segregations of lime; strong effervescence; strongly alkaline; clear, smooth boundary.

C2—32 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few, medium, distinct relict mottles of reddish yellow (7.5YR 6/8) and common, medium, distinct relict mottles of gray (5Y 6/1); massive; hard, firm, sticky and plastic; common medium segregations of lime; strong effervescence; strongly alkaline.

Depth to free carbonates ranges from 11 to 22 inches

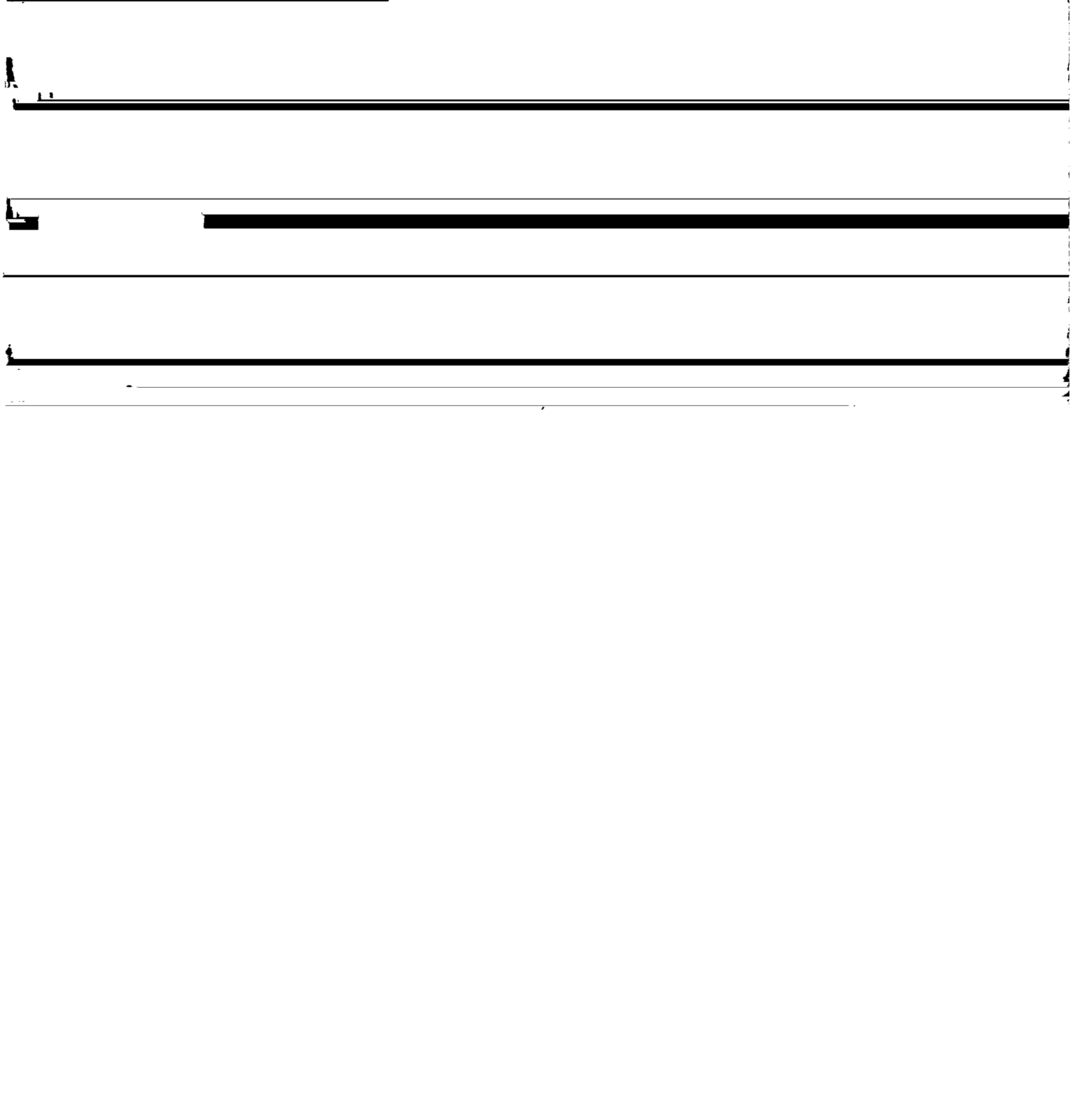


***Figure 8.*—This area of Parnell silty clay loam is well suited for wildlife habitat.**

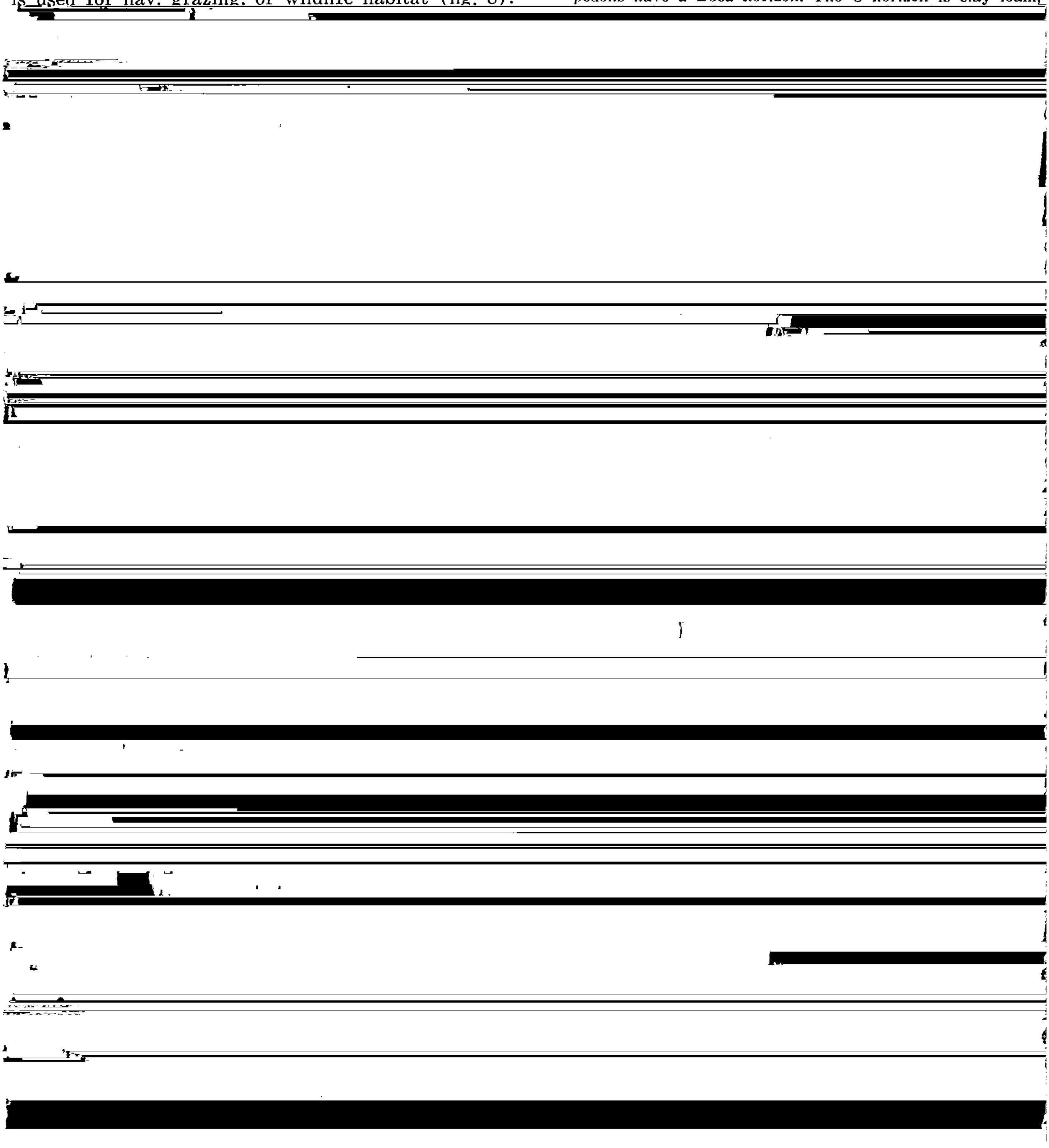
Representative profile of Parnell silty clay loam, 2,424 feet east and 66 feet south of the northwest corner of sec. 12, T. 123 N., R. 71 W.

O1—3 inches to 0, partially decayed organic material.

Cgca—48 to 60 inches, gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) moist; common, medium, distinct mottles of dark olive (5Y 3/4) moist; massive; hard, firm, sticky and plastic; common medium concretions of lime; strong effervescence; moderately alkaline.

If adequately drained, the soil is suited to most crops commonly grown in the county. In Edmunds County, however, drainage is not feasible on this soil in most areas. Most of the acreage is still native vegetation and is used for hay, grazing, or wildlife habitat (fig. 8).

brownish gray and is 2 to 6 inches thick. The B2t horizon ranges from very dark gray to light brownish gray in hue of 10YR or 2.5Y. The B2t horizon has prismatic structure that is weak or moderate and parts to moderate or strong blocky. It ranges from 12 to 24 inches in thickness. Some pedons have a B3ca horizon. The C horizon is clay loam,



Representative profile of Regan silt loam, 240 feet west and 75 feet south of the northeast corner of sec. 6, T. 122 N., R. 73 W.

O1—½ inch to 0, grayish-brown (10YR 5/1) mainly fibric materials, very dark brown (10YR 2/2) moist.

inches thick, is dark-gray heavy loam in the upper part and light brownish-gray loam in the lower part. The underlying material to a depth of 30 inches is calcareous, light brownish-gray loam. Calcareous, grayish-brown sand and gravel are at a depth of 30 inches.

during the summer months, and the soil is somewhat droughty in most years because it is underlain by sand and gravel. Runoff is slow. Conserving moisture is the chief management need.

This soil is well suited to all crops commonly grown

irregular in shape and range from 10 to 160 acres in size. Slopes commonly are short and convex. In section 20, T. 122 N., R. 67 W., this soil is underlain by loam or clay loam at a depth of about 3 feet, but in all other areas this soil has the profile described as replower 3 inches; common fine segregations of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—37 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; common medium segregations of lime;

acres in size. These soils are undulating because there are many narrow swales between rises. The Temvik soil is on the rises. It has a thinner surface layer than in the profile described as representative of the series. Eroded spots commonly are in cultivated fields, and in

B21t—13 to 17 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; weak, medium, prismatic structure parting to strong, fine, blocky; very hard, very firm, sticky and plastic; bleached sand grains on tops of prisms and along vertical faces of peds; neutral; gradual, smooth boundary.

B22t—17 to 24 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak, medium, prismatic structure parting to strong, medium, blocky;

undulating to hilly loamy soils on uplands. These soils formed in glacial till. The native vegetation is mainly mid and short grasses.

In a representative profile the surface layer is dark grayish-brown loam about 5 inches thick. The subsoil, about 8 inches thick, is clay loam that is dark grayish brown in the upper part and light brownish gray in the of ridges. William soils are in the lower parts of the landscape.

This Vida soil is too stony for use of farming or haying equipment. Runoff is medium.

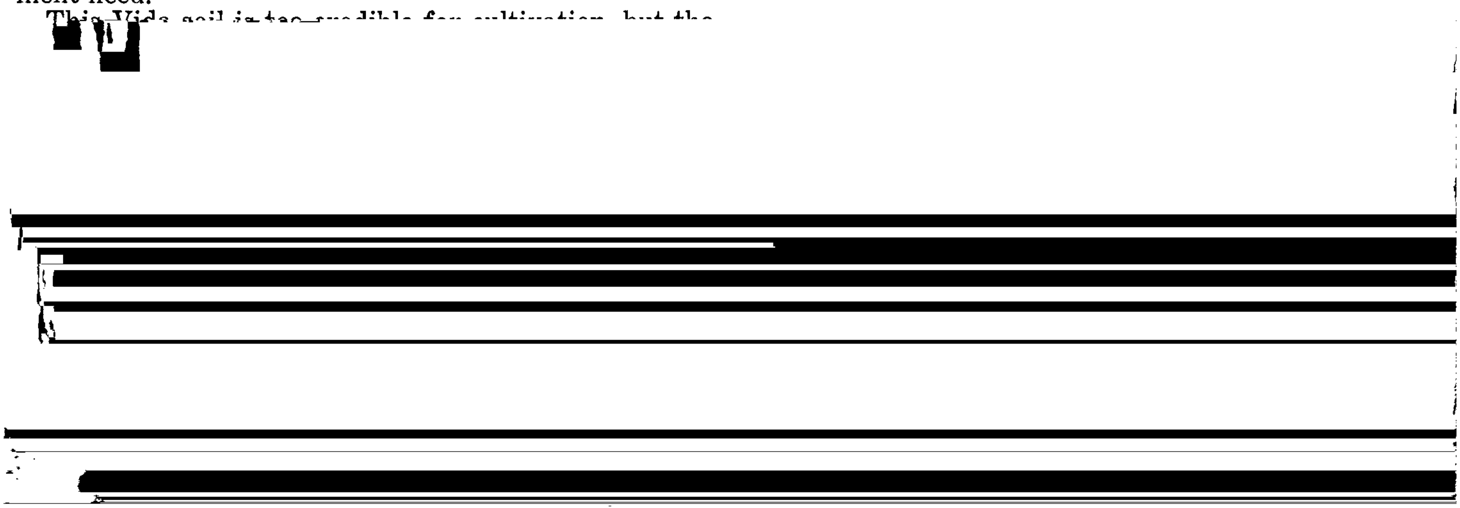
All of the acreage is still in native grass and is used for grazing. Capability unit VIIs–6; Silty range site; windbreak group 10.

VwC—Vida-Williams loams, 6 to 15 percent slopes. This mapping unit is about 45 percent Vida soils, 35 percent Williams soils, and 20 percent other soils. Areas are irregular in shape and range from 40 to 320 acres in size. The soils are undulating to rolling. Slopes are mostly short and convex. Stones are scattered on the surface on some of the ridges. Eroded spots are present in some of the cultivated areas, and in these areas the surface layer and subsoil have been mixed by plowing. The Vida soil is in the mid and higher parts of the landscape. It has the profile described as representative of the series. The Williams soil is in the lower part of the landscape.

Included with these soils in mapping are small areas of Bowbells, Tonka, and Zahill soils. Bowbells soils are in swales. Tonka soils are in small depressions, which are identified on the soil map by a wet spot symbol. Zahill soils are on the tops of the ridges and knolls.

Runoff is medium, and these soils have a severe hazard of erosion. Content of organic matter is low in the eroded spots. Controlling erosion is the chief management need.

This Vida soil is too erodible for cultivation, but the



Williams soil is suited to small grain and alfalfa. Many areas are cultivated. Some are still in native grass and are used for grazing or hay. Silty range site; Vida soil in capability unit VIe–3, windbreak group 10; Williams soil in capability unit IVe–1, windbreak group 3.

VzE—Vida-Zahill loams, 15 to 25 percent slopes. This mapping unit is about 45 percent Vida soils, 30 percent Zahill soils, and 25 percent other soils. These hilly soils are on uplands. Areas are irregular in shape and range from 20 to 160 acres in size. Slopes are short and convex. Stones are scattered on the surface in the higher parts of the landscape in some areas. Vida soils are in the middle parts of the landscape, and Zahill soils are in the higher parts. The Zahill soil has the profile described as representative of the series.

Included with these soils in mapping are small areas of Bowbells, Parnell, and Williams soils. Of these,

Figure 9.—**Sand and gravel in Wabek loam.**

very shallow to sand and gravel. They formed in glacial outwash. The native vegetation is mainly short grasses.

In a representative profile the surface layer is dark grayish-brown loam about 4 inches thick. The underlying material, to a depth of 7 inches, is calcareous, dark grayish-brown gravelly sandy loam. It is slightly hard when dry and very friable when moist. Below a depth of 7 inches it is calcareous, light-gray and light brownish-gray sand and gravel (fig. 9).

IIC2—7 to 60 inches, dominantly light-gray (2.5Y 7/2) and light brownish-gray (2.5Y 6/2) stratified sand and gravel, grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) moist; single grained; loose; strong effervescence; mildly alkaline.

Depth to stratified sand and gravel ranges from 7 to 14 inches. Depth to free carbonates ranges from 4 to 9 inches. The A1 horizon is dark grayish brown or grayish brown. It commonly is loam but in places is gravelly loam, gravelly sandy loam, or sandy loam. It is 4 to 7 inches thick. The IIC

of Cresbard, Niobell, Noonan, and Tonka soils. Cresbard soils are in swales with Bowbells soils. Niobell soils are intermingled with Williams soils in places.

undulating soils are on uplands. Areas are irregular in shape and range from 80 to 400 acres in size. They contain many narrow swales and deeply entrenched demoderate, fine and medium, granular structure; slightly hard, friable, slightly plastic; slight effervescence, mildly alkaline; clear, smooth boundary.

C1ca—4 to 18 inches, pale-brown (10YR 6/3) clay loam, olive brown (2.5Y 4/4) moist; common, medium, [illegible] relict mottles of brownish yellow (10YR 6/8);

limiting runoff, and controlling weeds. Minimum tillage, stubble mulching, crop residue use, wind stripcropping, field windbreaks or barriers, contour farming, terracing, and timely tillage are helpful measures. These practices also help control erosion and soil blowmake them unsuited to cultivation and that re-

planting is delayed temporarily by wetness of the mod-

***Figure 11.*—This 4-year-old, single-row field windbreak on Temvik-Bryant loams, 2 to 6 percent slopes, helps control soil blowing and traps snow.**

silt loam surface layer and a clay or silty clay subsoil.

These soils are moderate to moderately low in content of organic matter, are medium in fertility, and have high available water capacity. Permeability is slow. Runoff is ponded, but drainage has been provided or is feasible. In wet years fieldwork is delayed. Wetness is the chief concern of management. Other management needs are improving water intake and maintaining tilth and fertility.

If adequately drained, these soils are suited to all crops grown in the county. In wet years, they are better

matter, are medium in fertility, and have high available water capacity. Permeability is moderately slow or slow. Runoff is slow. These soils dry slowly in spring, and in summer the clayey subsoil releases moisture slowly to plants. If the soils are cultivated, tilth deteriorates and there is a moderate risk of soil blowing. Improving water intake, maintaining tilth, and controlling soil blowing are the chief management needs. Other management needs are conserving moisture and maintaining fertility.

These soils are well suited to all crops grown in the

Figure 12.—**Stubble mulching and a single-row field windbreak help trap snow for maximum moisture conservation in this area of Bryant loam, 0 to 2 percent slopes.**

These soils are well suited to all crops grown in the county. Wheat, oats, rye, corn, and alfalfa are the main crops.

Stubble mulching, crop residue use, minimum tillage, contour farming, terraces, and grassed waterways help control erosion and soil blowing, conserve moisture, and maintain fertility. If slopes are too irregular for contour farming and terracing, row crops should be planted infrequently, and the cropping system should

manure crops, application of manures, timely tillage, and chiseling or subsoiling help improve water intake and tilth and maintain fertility.

CAPABILITY UNIT IIIe-6

Bowdle loam, 2 to 6 percent slopes, is the only soil in this unit. It is a well-drained, gently sloping soil that is moderately deep to sand and gravel.

Many areas are cultivated. This soil is better suited to small grain and alfalfa than to corn.

Stubble mulching, crop residue use, timely tillage, chiseling or subsoiling, and grasses and legumes in the cropping system help improve water intake and con-

capacity. Permeability is moderate in the subsoil and moderately slow in the underlying material. Runoff is medium, and the hazard of erosion is severe. Controlling erosion is the chief management need. Other management needs are controlling soil blowing, conserving

CAPABILITY UNIT IVe-13

Letcher fine sandy loam is the only soil in this unit. It is a deep, moderately well drained to somewhat poorly drained, nearly level soil. It has a surface layer of fine sandy loam and sandy loam and a subsoil of sandy loam.

This soil is [illegible]

as corn. It is better suited to early maturing small grain.

Stubble mulching, crop residue use, minimum tillage, and wind stripcropping help conserve moisture and control soil blowing. Use of animal manures helps improve fertility and content of organic matter.

The narrow areas are dissected by meandering channels.

These soils are subject to flooding. The meandering channels make cultivation impractical in most areas.

Most areas are still in native vegetation and are used for grazing, hay, and wildlife habitat.

CAPABILITY UNIT VIw-4

Ranslo-Harriet silt loams are the only soils in this unit. They are deep, somewhat poorly drained and poorly drained, nearly level soils on bottom land. These soils have a claypan subsoil. The surface layer is silt loam and the subsoil is silty clay loam or silty clay.

These soils have a high water table and are subject to flooding. The claypan subsoil releases moisture slowly to plants. In places there are accumulations of salts in the lower part of the subsoil. In most areas these soils are not suited to cultivation.

Most areas are still in native grass and are used for grazing and hay. Uneven surfaces in some areas make haying difficult.

CAPABILITY UNIT VIs-1

This unit consists of deep, poorly drained to moderately well drained, level and nearly level soils in closed depressions and low areas on uplands. These soils have a claypan subsoil. They have a thin surface layer of silt loam or loam and a subsoil of clay or clay loam.

These soils take in water very slowly and release it slowly to plants. Runoff is slow to ponded. Water stays on the surface of ponded areas until it evaporates. These soils are wet early in the growing season but are dry

moderately slow in the underlying material. Runoff is medium, and the hazard of erosion is moderate to severe. This soil is too stony for cultivation or for use of haying machinery.

All areas are still in native grass and are used for grazing.

CAPABILITY UNIT VIIIw-1

This unit consists of Marsh. These areas are covered by shallow water during most years. Some areas contain open water surrounded by cattails, bulrushes, and reeds, and some areas are covered entirely by coarse aquatic plants. Marsh has little or no value for farming and grazing, but it is excellent for wildlife habitat.

Predicted yields

Table 2 lists the predicted average yields per acre of corn, oats, spring wheat, rye, and alfalfa for each soil judged suitable for crops. The predictions are for dry-farmed soils under two levels of management.

Yield predictions shown in column A of table 2 are those that can be expected under management that is customarily practiced in the county. Conservation crop rotations are lacking or are poorly planned, barnyard manure or green-manure crops are not extensively used, sloping soils are farmed up and down hill, the poorer soils are farmed along with the better soils, and commercial fertilizers are not used regularly as needed.

The predicted yields shown in column B are those that can be expected under careful and intensive management, which includes use of recommended

[Figures in columns A are the yields to be expected under prevailing management; those in columns B can be expected under improved management. Absence of a figure indicates the crop is not commonly grown on the soil or the soil is not suitable for that indiangrass, intermediate wheatgrass, reed canary-

bility in the subsoil and have moderate or high available

The main grass species suited to this group are tall wheatgrass and western wheatgrass.

PASTURE GROUP K

This group consists of deep, moderately well drained, loamy soils in swales in uplands. These soils have moderate permeability in the subsoil, have high available water capacity, and are high in fertility. Additional moisture is received in most years as runoff from adjacent soils. All climatically adapted pasture plants are suited to the soils in this group, and potential production is higher than on adjacent upland soils because of the favorable moisture.

Grasses and legumes suited to this group are alfalfa, big bluestem, green needlegrass, indiangrass, inter-

The range condition of a range site is determined by comparing present vegetation with the climax plant community as indicated by the range condition guide for the site. Components of the plant community are grouped according to their response to grazing on specific range sites. These groups are decreaser, increaser, and invader plants.

Decreaser plants are species in the climax plant community that decrease in abundance when subject to continued excessive grazing. *Increaser plants* are species in the climax plant community that increase in abundance when subject to continued excessive grazing. *Invader plants* are not members of the climax plant community for the site. They invade the community as a result of disturbances.

Big bluestem is the dominant grass on this site and is 75 to 90 percent of the vegetation in some areas.

lose vigor and thin out. They are replaced by inland saltgrass.

Figure 13.—Green needlegrass and western wheatgrass are the main grasses in this area of Silty range site. The pond furnishes water for livestock.

medium or high in fertility and most of them have high ... moderately slow and the clayey subsoil releases mois-

Little bluestem is the main species in the climax, dominant. Other grasses are needleandthread, buffalo benefits. They distribute and hold snow which prevents it from becoming a problem around the farmstead, and they protect the home and livestock from cold, wintery winds. Windbreaks also reduce fuel and feed costs; protect field crops, gardens, and orchards from damaging winds; reduce evaporation; provide a suitable habitat for many kinds of birds and other wildlife; help control erosion and soil blowing; and enhance the beauty of the rural home and its surroundings.

Before a windbreak is planted, the purpose of the planting, suitability of the soils, adaptability of trees and shrubs, and location of the planting should be considered. Improperly designed windbreaks can cause many problems.

Establishment of a windbreak and continued growth of the trees depend upon the careful selection of the site and upon the tree and shrub species planted. Adequate site preparation before planting and adequate maintenance after planting also are required. Grass and weeds should be eliminated before the trees are planted, and the regrowth of ground cover should be controlled during the life of the windbreak. Some replanting is likely to be needed in the first and second years after the initial planting.

The soils of Edmunds County are grouped into wind-

have low or moderate available water capacity. All of these soils have a moisture regime favorable to the growth of trees. Some receive additional moisture as runoff from adjacent soils, and some have a seasonal high water table. The hazard of erosion is slight, but some of the soils are calcareous and are moderately susceptible to soil blowing.

The soils in this group are well suited to all types of windbreaks and other kinds of woody plantings. All climatically adapted species of trees and shrubs have the potential to grow well.

WINDBREAK GROUP 2

The Ranslo part of Ranslo-Harriet silt loams is the only soil in this group. It is a deep, somewhat poorly drained, nearly level silty soil on bottom land. The subsoil is slowly permeable silty clay loam and silty clay. This soil has a high water table and is subject to occasional flooding. Runoff is slow. Susceptibility to erosion and soil blowing is slight. Wetness is the main limitation to growing trees on this soil.

If drainage is adequate, this soil is well suited to windbreaks and other kinds of woody plantings. Adapted trees and shrubs grow well because of the abundant supply of moisture, but some trees do not

TABLE 3.—*Height of trees and shrubs at 20 years of age, by windbreak suitability groups*

... others are estimates. Absence of entry indicates that the species normally is not suitable

Figure 14.—**A 2-year-old field windbreak on Williams-Bowbells loams, 3 to 6 percent slopes. Good site preparation and clean cultivation has resulted in an excellent stand of trees and shrubs.**

potential for survival, growth, and vigor is less than optimum

These soils are unsuited to windbreak plantings normally planted with machinery.

Figure 15.—Farmstead windbreak on Mondamin silty clay loam, 0 to 2 percent slopes. Such plantings also provide habitat for wildlife.

Farmland wildlife are animals that frequent cropland, pastures, meadows, and planted woodland. Although these animals use other areas, such as natural woodland and heavily vegetated marshland, they are most closely associated with the cultured areas. Ex-

extensive areas maintained in native plant communities, normally referred to as range. Extensive areas of range frequently include wooded draws, wooded alluvial land, farm areas, and some planted woodland. Range, however, is the major habitat element affecting means naturally occurring habitats can sometimes be maintained with specific management, but it is generally not possible or feasible to establish, construct, or improve habitat on these soils.

Engineering [8]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bed-

2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, 7, and 8, which show estimated physical

TABLE 4.—*Wildlife habitat, by soil associations*

Soil association	Percentage of association	Suitability of—			
		Farmland	Woodland	Wetland	Rangeland
1. Niobell-Noonan:					
Niobell	25	Fair	Very poor	Very poor	Good.
Noonan	20	Poor	Poor	Very poor	Poor.
Williams	[1]	Good	Very poor	Very poor	Good.
Heil	[1]	Very poor	Very poor	Poor	Poor.
2. Bryant:					
Bryant	55	Good	Very poor	Very poor	Good.
Grassna	[1]	Good	Very poor	Very poor	Good.
3. Williams-Bowbells:					
Williams	40	Good	Very poor	Very poor	Good.
Bowbells	20	Good	Poor	Poor	Fair.
Nishon	[1]	Poor	Poor	Good	Fair.
4. Williams-Vida:					
Williams	40	Good	Very poor	Very poor	Good.
Vida	20	Very poor	Very poor	Very poor	Fair.
Bowbells	[1]	Good	Poor	Poor	Fair.
Parnell	[1]	Very poor	Poor	Good	Fair.
5. Bryant-Mondamin:					
Bryant	40	Good	Very poor	Very poor	Good.
Mondamin	20	Good	Very poor	Very poor	Good.
Williams	[1]	Good	Very poor	Very poor	Good.
Parnell	[1]	Very poor	Poor	Good	Fair.
6. Temvik-Williams:					
Temvik	25	Good	Very poor	Very poor	Good.
Williams	20	Good	Very poor	Very poor	Good.
7. Lehr-Bowdle:					

TABLE 5.—*Estimated physical*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column

Soil series and map symbols	Depth to—		Depth from surface	Dominant USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Ft	*Ft*	*In*			
Bearden: Ba	>5	3–5	0–12	Loam	CL-ML or CL	A-6 or A-4
			12–40	Silt loam	CL-ML or CL	A-6 or A-4
			40–60	Silty clay loam	CL	A-6 or A-7
*Bowbells: Bc. For Cresbard part of Bc, see Cresbard series.	>5	>5	0–6	Loam	CL-ML or CL	A-6 or A-4
			6–26	Clay loam	CL	A-6 or A-7
			26–60	Clay loam	CL	A-6 or A-7
Bowdle: BoA, BoB	>5	>5	0–8	Loam	CL-ML or CL	A-6 or A-4
			8–22	Loam	CL-ML or CL	A-6 or A-4
			22–60	Sand and gravel	SC, SM, SW-SM, [illegible]	A-1 or A-2

and chemical properties

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the of this table. Symbol > means more than; symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*	*Mmhos/cm*			
100	100	85–95	60–75	15–35	5–20	0.6–2.0	0.18–0.20	7.9–8.4	<2	Low	High	Low.
100	100	90–100	70–90	25–40	5–25	0.2–0.6	0.14–0.17	7.9–8.4	2–4	Moderate	High	Low.
100	100	95–100	85–95	25–45	15–30	0.2–0.6	0.17–0.20	7.9–8.4	2–4	Moderate or high.	High	Low.

TABLE 5.—*Estimated physical*

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high water table	Depth from surface	Dominant USDA texture	Classification: Unified	Classification: AASHTO
	Ft	*Ft*	*In*			
Miranda. Mapped only with Niobell soils.	>5	>5	0–4	Loam	CL-ML or CL	A–4 or A–6
			4–10	Clay loam	CL or CH	A–6 or A–7
			10–60	Clay loam	CL	A–6 or A–7
*Mondamin: MdA, MdB, Mh. For Heil part of Mh, see Heil series.	>5	>5	0–6	Silty clay loam	CL	A–6 or A–7
			6–13	Silty clay	CH or CL	A–7
			13–60	Silty clay loam	CL	A–6 or A–7
*Niobell: NmA, NpB. For Miranda part of NmA, see Miranda series; for Noonan part of NpB, see Noonan series.	>5	>5	0–6	Loam	CL-ML or CL	A–4 or A–6
			6–16	Clay loam	CL	A–6
			16–26	Clay loam	CL	A–6 or A–7
			26–60	Clay loam	CL	A–6 or A–7
Nishon. Mapped only with Tonka and Williams soils.	>5	>5	0–10	Silt loam	CL-ML or CL	A–6 or A–4
			10–22	Clay	CH or MH	A–7
			22–60	Clay loam	CL or CH	A–6 or A–7
Noonan. Mapped only with Niobell soils.	>5	>5	0–10	Loam	CL-ML or CL	A–4 or A–6
			10–22	Clay loam	CL or CH	A–6 or A–7
			22–60	Clay loam	CL	A–6 or A–7
Parnell: Pa	>5	0–6	0–6	Silty clay loam	CL or CH	A–6 or A–7
			6–32	Silty clay	CH or MH	A–7
			32–60	Silty clay loam	CL or CH	A–7
*Ranslo: Rh. For Harriet part of Rh, see Harriet series.	>5	<4	0–9	Silt loam	CL-ML or CL	A–4 or A–6
			9–26	Silty clay loam	CH or CL	A–7
			26–35	Silty clay	CH	A–7
			35–60	Clay loam	CL or CH	A–6 or A–7
Regan: Rn	>5	0–2	0–5	Silt loam	CL-ML or CL	A–4 or A–6
			5–24	Silt loam	CL	A–6 or A–7
			24–44	Silt loam	CL	A–6 or A–7
			44–60	Sand and gravel	SC, SM, GC, GM, or SW-SM	A–1 or A–2
Spottswood: Sp	>5	3–6	0–20	Loam	CL-ML or CL	A–4, A–6, or A–7
			20–30	Loam	CL	A–6

and chemical properties—Continued

TABLE 5.—*Estimated physical*

Soil series and map symbols	Depth to—		Depth from surface	Dominant USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Ft	*Ft*	*In*			
*Wabek: WaD, WbC. For Bowdle part of WbC, see Bowdle series.	>5	>5	0–4 4–7 7–60	Loam Gravelly sandy loam Sand and gravel	ML or CL SM or SC SC, SM, GC, GM, or SW-SM	A–6 or A–4 A–2 or A–4 A–1 or A–2
*Williams: WnB, WnC, WtA, WtB, WvC. For Bowbells part of these units, see Bowbells series; for Nishon part of WtB, see Nishon series; for Parnell part of WvC, see Parnell series.	>5	>5	0–4 4–10 10–24 24–60	Loam Clay loam Clay loam Clay loam	CL-ML or CL CL CL CL	A–6 or A–4 A–6 or A–7 A–6 or A–7 A–6 or A–7
Zahill. Mapped only with Vida soils.	>5	>5	0–4 4–18 18–60	Loam Clay loam Clay loam	CL-ML or CL CL-ML or CL CL	A–6 or A–4 A–6 or A–7 A–6 or A–7

[1] Nonplastic.

to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large stones or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope; and if the floor needs to be

that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 6 apply only to a depth of *and chemical properties*—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Risk of corrosion	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Uncoated steel	Concrete
				Pct		*In per hr*	*In per in of soil*	*pH*	*Mmhos/cm*			
100	95–100	85–95	60–75	15–35	5–20	0.6–2.0	0.18–0.20	6.6–7.3	<2	Low	Moderate	Low.
60–85	50–70	30–50	25–40	5–20	NP–10	2.0–6.0	0.09–0.13	7.4–7.8	<2	Low	Moderate	Low.
40–80	25–75	15–70	5–30	0–20	NP–10	6.0–20.0	0.03–0.06	7.4–7.8	<2	Low	Low	Low.
100	95–100	85–95	60–75	20–40	5–20	0.6–2.0	0.18–0.20	6.6–7.3	<2	Low	Low	Low.
100	90–100	85–95	70–90	25–50	10–30	0.6–2.0	0.19–0.22	6.6–7.3	<2	Moderate	High	Low.
100	90–100	85–95	70–90	25–50	10–30	0.6–2.0	0.17–0.20	6.6–7.8	<2	Moderate	High	Low.
100	95–100	85–95	70–90	25–50	10–30	0.2–0.6	0.17–0.20	7.4–8.4	0–4	Moderate	High	Low.
100	95–100	85–95	60–90	20–40	5–20	0.6–2.0	0.18–0.20	7.4–7.8	<2	Low	Low	Low.
100	90–100	85–95	70–90	30–45	10–25	0.6–2.0	0.17–0.20	7.9–8.4	<2	Moderate	Moderate	Low.
100	95–100	85–95	70–90	25–45	10–30	0.2–0.6	0.17–0.20	7.9–8.4	0–4	Moderate	High	Low.

the shrink-swell potential, indicate traffic supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided

and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among factors that are unfavorable.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure;

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill	Local roads and streets
Bearden: Ba	Severe: moderately slow permeability; seasonal high water table.	Moderate: seasonal high water table at 3 to 5 feet.	Severe: seasonal water table; somewhat poorly drained.	Severe: somewhat poorly drained.	Severe: seasonal high water table.	Severe: high potential frost action.
*Bowbells: Bc For Cresbard part of Bc, see Cresbard series.	Severe: moderately slow permeability in substratum.	Slight	Moderate: moderately well drained.	Moderate: moderately well drained; moderate shrink-swell potential. Severe if not protected from flooding.	Severe: water accumulates from adjacent slopes.	Severe: AASHTO group index more than 8; CL material with PI more than 15.
Bowdle: BoA, BoB	Slight [1]	Severe: rapid permeability in substratum.	Severe: sand and gravel below 20 inches.	Slight	Severe: rapid permeability in substratum.	Slight
[illegible]	Moderate:	Moderate if	Slight	Moderate:	Slight	Moderate or

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill	Local roads and streets
Divide: Dv	Severe: seasonal high water table.	Severe: rapid permeability in substratum.	Severe: moderately well drained or somewhat poorly drained; sand and gravel at 20 to 40 inches.	Moderate or severe: moderately well drained or somewhat poorly drained.	Severe: seasonal high water table; rapid permeability in substratum.	Moderate: moderately well drained or somewhat poorly drained; moderate potential frost action.
Edgeley: EdE	Severe: less than 40 inches to shale.	Severe: slopes more than 6 percent.	Moderate: clay loam subsoil; rippable shale at 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable shale at 20 to 40 inches.	Moderate: rippable shale at 20 to 40 inches.	Moderate: moderate shrink-swell potential.
Grassna: Gr	Moderate:	Moderate:	Moderate:	Moderate:	Moderate:	Moderate:

interpretations—Continued

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill	Local roads and streets
[redacted]						

interpretations—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand and	Topsoil	Pond reservoir	Embank-ments, dikes,	Drainage	Irrigation	Terraces and	Grassed

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill	Local roads and streets
Parnell: Pa	Severe: slow permeability.	Severe: frequent ponding; slight if water is not	Severe: very poorly drained; frequent	Severe: frequent ponding; high shrink-swell	Severe: frequent ponding; very poorly	Severe: frequent ponding; very poorly

interpretations—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Poor: very poorly drained; AASHTO group index more than 8; high shrink-swell potential.	Unsuited	Poor: very poorly drained.	Slow permeability; low seepage.	Medium or low shear strength; high compressibility; low permeability of compacted soil.	Slow permeability; subject to frequent ponding; generally no outlets.	Subject to ponding; very slow intake rate.	[2]	[2].
Poor: high shrink-swell potential.	Unsuited	Fair: surface less than 16 inches thick.	Water table 3 to 5 feet in most years.	Medium or low shear strength; medium or high compressibility; fair or poor compaction.	Slow permeability; subject to flooding; water table at 3 to 5 feet.	Subject to flooding; slow permeability; water table.	[2]	[2].
Poor: very poorly drained; high susceptibility to frost action.	Unsuited	Poor: very poorly drained.	Water table within 2 feet in most years.	Medium or low shear strength; medium or high compressibility; fair to poor compaction.	Moderate permeability; high water table.	High water table; very poorly drained.	[2]	[2].
Good	Fair or poor depending on amount of fines.	Good	Rapid permeability in underlying material; seasonal high water table.	Medium or high shear strength; fair or good compaction; susceptible to piping.	Rapid permeability in underlying material; seasonal water table.	Sand and gravel at 20 to 40 inches; low or moderate available water capacity.	[2]	[2].
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[2]	[2]

TABLE 6.—*Engineering*

Soil series and	Degree and kind of limitation for—					

interpretations—Continued

Suitability as source of—			Soil features affecting—					
	[illegible]		Pond	Embank- [illegible]			Terraces	[illegible]

TABLE 7.—*Engineering*

[Tests performed by the South

Soil name	Parent material	Depth	Moisture density [1]	
			Maximum dry density	Optimum moisture
			Lb per cu ft	*Pct*
Bowdle loam: 462 feet east and 102 feet south of northwest corner of sec. 6, T. 122 N., R. 73 W. (Modal)	Alluvium.	7–16 19–23 23–60	110 108 116	16 18 14
Bryant loam: 138 feet west and 736 feet south of northeast corner of sec. 20, T. 124 N., R. 73 W. (Modal)	Silty glacial drift.	6–14 18–49 49–60	100 112 111	19 15 18
Grassna loam: 1,104 feet east and 153 feet north of south quarter corner of sec. 25, T. 122 N., R. 66 W. (Modal)	Alluvium.	7–13 19–36 43–60	96 106 117	21 18 14
Heil silt loam: 291 feet north and 252 feet west of southeast corner of sec. 16, T. 123 N., R. 71 W. (Modal)	Glacio-lacustrine sediments.	9–25 25–52 52–60	91 93 102	29 27 20
Niobell loam: 810 feet east and 123 feet north of southwest corner of sec. 16, T. 123 N., R. 66 W. (Modal)	Glacial till.	11–18 23–41 41–60	105 111 109	18 17 17
Parnell silty clay loam: 315 feet east and 84 feet south of northwest corner of sec. 12, T. 121 N., R. 66 W. (Modal)	Local alluvium.	6–33 38–60	91 92	25 22
Williams loam: 87 feet east and 89 feet south of northwest corner of sec. 24, T. 123 N., R. 70 W. (Modal)	Glacial till.	5–14 19–33 33–60	104 105 109	18 19 18

[1] Based on AASHTO Designation T 99, Method A (*1*).

[2] Mechanical analysis according to AASHTO Designation: T 88. Results by this procedure frequently may differ somewhat from cedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the pipette method and the material coarser than 2 millimeters is excluded from calculations of grain-size fractions. The mechanical

[3] Based on AASHTO Designation M 145-49.

8 may differ from those given for the same series in table 5.

Formation and Classification of the Soils

This section describes the major factors of soil formation as they relate to the soils of Edmunds County. It also explains the system of classifying soils in broader

are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has been accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the *test data*

Dakota Department of Highways]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than 0.005 mm			AASHTO [3]	Unified
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)					
					Pct			
99	97	84	59	20	34	11	A-6(5)	CL
96	89	65	31	17	28	6	A-2-4(0)	SM-SC
89	80	41	11	2	21	1	A-1-6(0)	SW-SM
-----------	100	99	93	29	37	12	A-6(9)	ML or CL
-----------	100	99	93	27	33	11	A-6(8)	CL
-----------	100	99	94	21	35	13	A-6(9)	CL
-----------	100	96	79	29	40	15	A-6(10)	ML or CL
-----------	100	96	79	33	39	17	A-6(11)	CL
100	99	93	67	20	29	10	A-4(6)	CL
-----------	-----------	100	98	57	61	32	A-7-6(20)	CH
-----------	-----------	100	97	55	59	32	A-7-6(20)	CH
-----------	-----------	100	98	41	47	21	A-7-6(13)	CL
-----------	100	94	67	31	37	14	A-6(7)	CL
97	95	87	62	35	38	20	A-6(9)	CL

TABLE 8.—*Engineering test data for soil*

[Tests were made by the South Dakota Department of

Soil series	Horizon	Number of samples tested	Mechanical analysis[1]					
			Percentage less than 3 inches passing sieve—					
			No. 10 (2.0 mm)		No. 40 (0.42 mm)		No. 200 (0.074 mm)	
			Range	Average	Range	Average	Range	Average
Bowbells.	A	8	97–100	99	90–98	94	72–84	78
	B	20	95–100	98	88–100	94	62–90	76
	C	6	94–100	97	89–96	93	64–82	73
Cresbard.	A	12	95–100	99	88–100	94	54–85	70
	B	24	94–100	98	87–100	94	62–95	78
	C	26	92–100	96	84–97	90	44–88	66
Divide.	B	1	----------	89	----------	75	----------	50
	C	2	48–100	80	28–94	61	21–60	41
	2C	8	26–100	68	11–100	56	0–87	39
Harriet.	A	1	----------	100	----------	98	----------	81
	B	5	99–100	100	97–100	99	89–98	94
	C	10	97–100	99	92–100	97	74–100	88
Heil.	A	1	----------	97	----------	90	----------	68
	B	4	94–100	98	85–100	93	61–97	79
Letcher.	A	1	----------	98	----------	88	----------	51
	B	3	41–100	78	18–100	62	16–62	39
	C	4	74–100	94	57–100	82	9–54	31
Miranda.	A	1	----------	99	----------	96	----------	82
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

samples taken along proposed highway routes

Highways. Dashed lines indicate no data available]

Percentage smaller than 0.005 mm		Liquid limit [2]		Plasticity index [3]		Classification			Estimated CBR [6]
Range	Average	Range	Average	Range	Average	AASHTO [4]	AASHTO [5]	Unified	

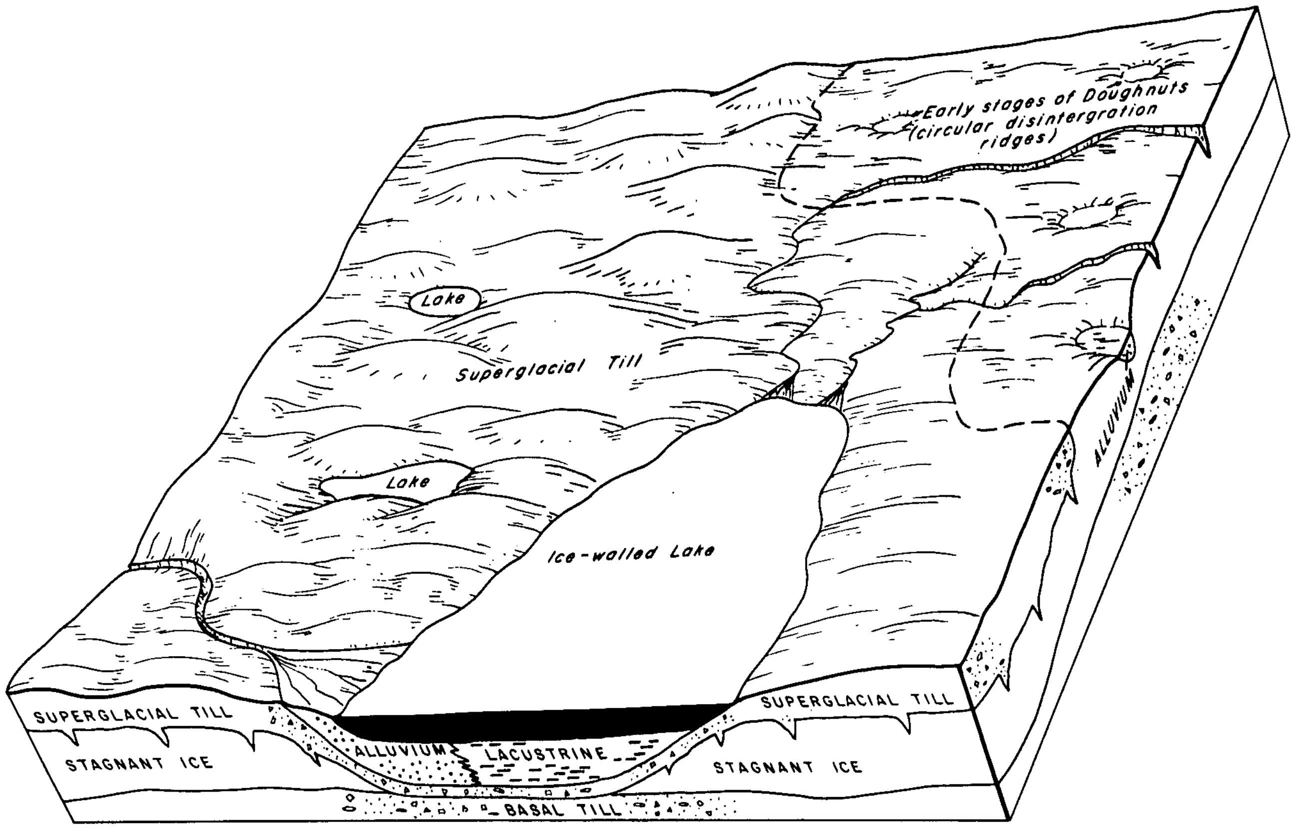


Figure 17.—Top: Missouri Coteau landscape during glacial period. Bottom: Same landscape today.

pattern is poorly defined and potholes, or closed depressions, are numerous. The glacial till in this area is an unassorted mixture of silt, clay, sand, and gravel in proportions that differ from one place to another. Cobbles and stones commonly are scattered throughout the till. Niobell, Vida, Williams, and Zahill soils are examples of soils formed in glacial till.

Within the Missouri Coteau area are two other kinds of glacial deposits, glacial outwash and glacial lacustrine. The glacial outwash consists of stratified sand and gravel that was deposited on nearby landscapes by large volumes of meltwater from the retreating glacier. Bowdle, Lehr, Spottswood, and Wabek soils formed in or are underlain by glacial outwash.

Much of the running water from the melting glacier collected in glacial lakes that were ice-walled and surrounded by superglacial till resting on stagnant ice. The subsequent subsiding of the surrounding areas drained the lakes and resulted in perched lake plains. The lacustrine sediments deposited in these glacial [illegible]

climate. Additional climatic data are given in the section "Environmental Factors Affecting Soil Use."

Plant and animal life

Plants, animals, insects, earthworms, bacteria, and fungi are important in soil formation. The kinds and amounts of plants under which the soils formed affect the content of organic matter in the surface layer and the amounts of nutrients in the soil. Earthworms and burrowing animals help keep the soil open and porous. Bacteria and fungi help decompose the plant residues changing the organic matter into the more stable humus as well as releasing nutrients for plant food.

The natural vegetation of the county was mainly mid and tall grasses. Consequently, the soils in the county are moderate to high in content of organic matter and medium to high in fertility and have granular structure in the surface layer.

Relief

Relief influences soil formation through its affect

TABLE 9.—*Classification of the soils*

Series	Family	Subgroup	Order
Bearden	Fine-silty, frigid	Aeric Calciaquolls	Mollisols.
Bowbells	Fine-loamy, mixed	Pachic Argiborolls	Mollisols.
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed	Pachic Haploborolls	Mollisols.
Bryant	Fine-silty, mixed	Typic Haploborolls	Mollisols.
Cresbard	Fine, mixed	Glossic Udic Natriborolls	Mollisols.
Divide	Fine-loamy over sandy or sandy-skeletal, frigid	Aeric Calciaquolls	Mollisols.
Edgeley	Fine-loamy, mixed	Udic Haploborolls	Mollisols.

groups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups may have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Haplaquolls* (a typical Haplaquoll).

FAMILY: Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name consists of a series of adjectives, preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 9). An example is the coarse-loamy, mixed, mesic family of Typic Haplaquolls.

Environmental Factors Affecting Soil Use

This section describes the natural and cultural features in Edmunds County that affect the use and management of soils.

Geology

All of Edmunds County is within the glaciated part of the Northern Great Plains. Much of the county is covered by unassorted drift or glacial till that is clay loam or heavy loam. Stratified silty drift is mainly in the eastern part of the county, but small scattered areas occur elsewhere.

Deposits of glacial outwash are mainly in the western part of the county and are a source of sand and gravel for construction and road uses. Sand and gravel deposits are scarce in the eastern part of the county and are mostly near the larger drainageways.

The climatic summary for Edmunds County is based on data recorded by cooperative observers of the National Oceanic and Atmospheric Administration at Ipswich and Roscoe in the central part of the county. The elevation at Ipswich is 1,541 feet and at Roscoe is 1,829 feet. The data is for the period 1941–70. There is a slight climatic gradient from east to west across the county, but the climate at Ipswich and Roscoe is representative for the county. Climate is a limiting factor in the production of most crops in the county.

The temperature range from summer to winter, and at times from day to day, is large in the county. Summer temperatures climb above 90° F on an average of 21 days in a year. Temperatures above 100° occur 3 days a year. The warmest summer month during the period 1941–70 was July 1966, when the average maximum temperature was 90.4° and the average minimum temperature was 62.5°. In winter, the minimum temperature drops to 20° below zero or lower about 5 times a year. Temperatures of 30° below zero occur about once in two years. The coldest month during the period 1941–70 was January 1950, when the average maximum temperature was 5.8°, and the average minimum temperature was 13.5° below zero. There are about 42 days a year when the minimum temperature drops below zero.

Data on temperature and precipitation are given by month in table 10. The least amount of precipitation was in 1952 when the annual precipitation was 8.62 inches, and the greatest amount was in 1968 when 24.88 inches was recorded. Growing season precipitation ranged from 5.60 inches in 1952 to 21.15 inches in 1968. Most of the rainfall during the growing season comes from thunderstorms of widely differing intensity. About once a year, rainfall of 1 inch falls in one hour; about once in 12 years, 2 inches of rain falls in one hour; 2 inches fall in 24 hours once in 2 years; and a 3-inch rainfall in 24 hours occurs about once in 5 years.

Table 11 gives the probabilities of specified temperatures after certain dates in the spring and below certain dates in the fall. This table shows the probability is 50 percent, or 5 years out of 10, that a temperature of 32° or lower will occur on or after May 14.

Similarly, table 11 shows the probability is 50 percent that a temperature of 32° will occur on or before

Relief

TABLE 10.—*Temperature and precipitation*

[Based on data recorded at Ipswich and Roscoe, South Dakota, 1941–70]

Month	Temperature				Precipitation							
	Average daily maximum	Average daily minimum	2 years in 10 will have— Average daily maximum equal to or higher than—	2 years in 10 will have— Average daily minimum equal to or lower than—	Average total	Maximum total	Minimum total	1 year in 10 will have— Less than—	1 year in 10 will have— More than—	Average snowfall	Average number of days with— Snowfall of 1 inch or more	Average number of days with— Snow cover of 1 inch or more
	°F	*°F*	*°F*	*°F*	*In*	*In*	*In*	*In*	*In*	*In*		
January	22.2	0.6	33.5	−7.4	0.42	1.29	[1]	0.059	0.901	5.5	5	13
February	28.1	4.9	36.2	−1.7	.50	2.06	[1]	.092	1.021	5.2	2	12
March	38.6	16.3	47.9	8.8	.77	3.26	.06	.161	1.571	6.0	2	9
April	57.6	31.7	64.2	27.5	1.94	6.67	.16	.465	3.856	2.0	[2]	[2]
May	69.7	42.6	74.7	38.6	2.67	5.33	.38	1.017	4.694	1.0	[2]	[2]
June	78.1	52.8	83.6	49.8	4.02	7.46	.64	1.893	6.533	--------	0	0
July	85.9	57.8	90.3	54.8	2.46	4.83	.56	1.014	4.835	--------	0	0
August	85.7	56.0	90.3	53.3	2.02	4.54	[1]	.707	3.604	--------	0	0
September	75.0	45.2	79.0	42.4	1.50	4.51	.15	.371	2.961	--------	[2]	[2]
October	63.0	34.6	69.0	30.8	1.02	3.04	[1]	.118	2.261	.2	[2]	[2]
November	42.4	20.0	49.3	14.3	.68	3.07	[1]	.035	1.598	2.9	1	5
December	28.2	7.2	35.7	.7	.35	1.44	[1]	.032	.750	4.6	2	10
Year	56.2	30.8	--------	--------	18.35	[3] 24.88	[4] 8.62	14.71	22.72	27.4	12	50

[1] Trace.
[2] Less than 0.5 day.
[3] In 1968.
[4] In 1952.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[Based on data recorded at Roscoe, South Dakota, 1941–70]

Probability	Dates for given probability and temperature					
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
After a specified date in spring:						
90 percent	March 12	March 20	March 31	April 12	April 25	May 5
70 percent	March 20	March 29	April 9	April 20	May 2	May 12
50 percent	April 2	April 14	April 23	May 3	May 14	May 23
30 percent	April 15	April 19	May 6	May 16	May 26	June 3
10 percent	April 22	May 8	May 15	May 24	June 2	June 10
Before a specified date in fall:						
10 percent	October 14	October 6	September 24	September 15	September 7	August 20
30 percent	October 24	October 13	October 1	September 22	September 14	August 31
50 percent	November 4	October 24	October 12	October 3	September 26	September 18
70 percent	November 15	November 4	October 23	October 14	October 7	October 7
90 percent	November 21	November 10	October 30	October 21	October 14	October 7

shine is in July and August when sunshine can be expected 75 percent of the time.

Windspeed averages about 11 miles per hour in summer when the prevailing wind is from the southeast. During winter the wind averages 14 miles per hour and the prevailing direction is from the northwest. A windspeed of more than 50 miles per hour can occur during any month but is more likely to occur in the summer accompanying thunderstorms. Thunderstorms occur on an average of about 40 to 45 days per year. Hail occasionally accompanies the thunderstorms and can be expected about twice in a year. Hail is most likely to fall in July.

The relative humidity differs widely from early morning to afternoon and from day to day. The annual average is about 80 percent in the morning and 60 per-

side markets. U. S. Highway 12 connects the towns of Bowdle, Ipswich, and Roscoe to points east and west. State Highways 45 and 47 are the main north and south roads. Hard-surfaced and graveled secondary roads feed into the main highways so that all parts of the county have easy access to shopping and market

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(9) ————. 1960. Soil classification, a comprehensive system, 7th Approximation. 265 pp., illus. (Supplemnts issued in March 1967 and September 1968)
(10) United States Department of Defense. 1968. Unified soil classification system for roads, airfields, embankments and foundations. MIL–STD–619B, 30 pp.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Conservation cropping system. Growing crops in combination with needed cultivation and management. Cropping systems include rotations that contain grasses and legumes and rotations in which the desired results are achieved without the use of such crops.

Continental climate. The climate in areas distant from the ocean; characterized by considerable variation in temperature and in other weather conditions.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Crop residue. A system of retaining crop residue on land between harvest and replanting to prevent erosion and insure future crop production.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable face, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and

exchangeable sodium. Salinity classes of soils are based on the electrical conductivity of the saturation extract, as expressed in millimhos per centimeter at 25° C. The salinity classes and their numerical ratings of electrical conductivity are as follows:

Salinity classes	*Numerical ratings (millimhos per centimeter)*
None	Less than 2.0
Low	2.0 to 4.0

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wind stripcropping. Growing crops in strips that run crosswise to the general direction of prevailing wind and without strict adherence to the contour of the land.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs.

Map symbol	Mapping unit	Page	Capability unit		Pasture group		Range site		Windbreak group	
			Symbol	Page	Letter	Page	Name	Page	Number	Page
Ba	Bearden loam------------------------	9	IIe-4	34	F	42	Silty	44	1	47
Bc	Bowbells-Cresbard loams-------------	10	IIc-3	36	--	--	---------	--	--	--
	Bowbells soil-------------------	--	-----------	--	K	43	Overflow	44	1	47
	Cresbard soil-------------------	--	-----------	--	E	42	Clayey	45	4	47
BoA	Bowdle loam, 0 to 2 percent slopes--	11	IIIs-2	38	D	42	Silty	44	6	48
BoB	Bowdle loam, 2 to 6 percent slopes--	11	IIIe-6	37	D	42	Silty	44	6	48
BrA	Bryant loam, 0 to 2 percent slopes--	12	IIc-2	35	F	42	Silty	44	3	47
BrB	Bryant loam, 2 to 6 percent slopes--	12	IIe-1	34	F	42	Silty	44	3	47
BrC	Bryant loam, 6 to 9 percent slopes--	12	IIIe-1	36	F	42	Silty	44	3	47
BvA	Bryant loam, sandy substratum, 1 to 3 percent slopes-------------	12	IIIs-2	38	D	42	Silty	44	6	48
BxB	Bryant-Grassna loams, 2 to 6 percent slopes---------------------------	12	IIe-1	34	--	--	Silty	44	--	--
	Bryant soil--------------------	--	-----------	--	F	42	---------	--	3	47
	Grassna soil-------------------	--	-----------	--	K	43	---------	--	1	47
Dv	Divide loam------------------------	13	IIIs-4	38	D	42	Silty	44	1	47
EdE	Edgeley loam, 6 to 20 percent slopes---------------------------	14	VIe-1	39	F	42	Silty	44	10	49
Gr	Grassna loam-----------------------	15	IIc-3	36	K	43	Overflow	44	1	47
He	Heil silt loam---------------------	16	VIs-1	40	B	42	Closed Depression	44	10	49
LeA	Lehr loam, 0 to 3 percent slopes----	17	IVs-1	39	D	42	Shallow to Gravel	46	10	49
LeB	Lehr loam, 3 to 6 percent slopes----	17	IVe-6	38	D	42	Shallow to Gravel	46	10	49
LhB	Lehr-Bowdle loams, 0 to 6 percent slopes---------------------------	17	IVe-6	38	D	42	---------	--	--	--
	Lehr soil----------------------	--	-----------	--	--	--	Shallow to Gravel	46	10	49
	Bowdle soil--------------------	--	-----------	--	--	--	Silty	44	6	48
Lt	Letcher fine sandy loam-------------	18	IVe-13	39	H	42	Sandy	44	5	48
Lv	Loamy Fluvaquents-------------------	18	VIw-3	39	--	--	Overflow	44	10	49
Mb	Marsh-------------------------------	18	VIIIw-1	40	--	--	---------	--	--	--
MdA	Mondamin silty clay loam, 0 to 2 percent slopes--------------------	20	IIs-1	35	I	42	Clayey	45	4	47
MdB	Mondamin silty clay loam, 2 to 6 percent slopes--------------------	20	IIIe-3	37	I	42	Clayey	45	4	47
Mh	Mondamin-Heil silty clay loams------	20	-----------	--	--	--	---------	--	--	--
	Mondamin soil------------------	--	IIs-1	35	I	42	Clayey	45	4	47
	Heil soil----------------------	--	VIs-1	40	B	42	Thin Claypan	46	10	49
NmA	Niobell-Miranda loams, 0 to 3 percent slopes--------------------	21	-----------	--	--	--	---------	--	--	--
	Niobell soil-------------------	--	IIIs-1	37	E	42	Clayey	45	4	47
	Miranda soil-------------------	--	VIs-1	40	--	--	Thin Claypan	46	10	49
NpB	Niobell-Noonan loams, 1 to 5 percent slopes--------------------	21	IIIe-3	37	--	--	---------	--	--	--
	Niobell soil-------------------	--	-----------	--	E	42	Clayey	45	4	47
	Noonan soil--------------------	--	-----------	--	C	42	Claypan	46	9	49
Pa	Parnell silty clay loam------------	23	Vw-4	39	B	42	Wetland	43	10	49

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Symbol	Capability unit: Page	Pasture group: Letter	Pasture group: Page	Range site: Name	Range site: Page	Windbreak group: Number	Windbreak group: Page
Rh	Ranslo-Harriet silt loams-----------	24	VIw-4	40	--	--	---------	--	--	--
	Ranslo soil--------------------	--	-----------	--	B	42	Subirrigated	43	2	47
	Harriet soil-------------------	--	-----------	--	J	42	Saline Lowland	44	10	49
Rn	Regan silt loam---------------------	25	Vw-4	39	J	42	Wetland	43	10	49
Sp	Spottswood loam---------------------	25	IIIs-2	38	D	42	Silty	44	3	47
TaB	Tally fine sandy loam, 2 to 6 percent slopes--------------------	26	IIIe-8	37	H	42	Sandy	44	5	48
TbB	Temvik-Bryant loams, 2 to 6 percent slopes--------------------	27	IIe-1	34	F	42	Silty	44	3	47
TgB	Temvik-Grassna loams, 3 to 6 percent slopes--------------------	27	IIe-1	34	--	--	Silty	44	--	--
	Temvik soil---------------------	--	-----------	--	F	42	---------	--	3	47
	Grassna soil--------------------	--	-----------	--	K	43	---------	--	1	47
TgC	Temvik-Grassna loams, 6 to 9 percent slopes--------------------	27	IIIe-1	36	--	--	Silty	44	--	--
	Temvik soil---------------------	--	-----------	--	F	42	---------	--	3	47
	Grassna soil--------------------	--	-----------	--	K	43	---------	--	1	47
Tn	Tonka-Nishon silt loams[1]-----------	28	IIw-1[2] IVw-1[3]	34 39	A[2] B[3]	41 42	Closed Depression	44	10	49
VdC	Vida stony loam, 3 to 15 percent slopes----------------------------	28	VIIs-6	40	--	--	Silty	44	10	49
VwC	Vida-Williams loams, 6 to 15 percent slopes--------------------	29	-----------	--	F	42	Silty	44	--	--
	Vida soil-----------------------	--	VIe-3	39	--	--	---------	--	10	49
	Williams soil-------------------	--	IVe-1	38	--	--	---------	--	3	47
VrF	Vida-Zahill loams, 15 to 25 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Map symbol	Mapping unit	Page	Capability unit		Pasture group		Range site		Windbreak group	
			Symbol	Page	Letter	Page	Name	Page	Number	Page
WtB	Williams-Bowbells-Nishon complex, 2 to 6 percent slopes-------------	32	-----------	--	--	--	---------	--	--	--
	Williams soil-------------------	--	IIe-2	34	F	42	Silty	44	3	47
	Bowbells soil-------------------	--	IIe-2	34	K	43	Silty	44	1	47
	Nishon soil[1/]-------------------	--	IIw-1[2/]	34	A[2/]	41	Closed	44	10	49
			IVw-1[3/]	39	B[3/]	42	Depression			
WvC	Williams-Bowbells-Parnell complex, 6 to 9 percent slopes-------------	32	-----------	--	--	--	---------	--	--	--
	Williams soil-------------------	--	IIIe-2	37	F	42	Silty	44	3	47
	Bowbells soil-------------------	--	IIIe-2	37	K	43	Silty	44	1	47
	Parnell soil--------------------	--	Vw-4	39	B	42	Wetland	43	10	49

1/ Status of artificial drainage and feasibility of drainage determined by onsite inspection.

2/ Drained.

3/ Undrained.

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